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ABSTRACT

Home movies of eight normal children and eight children later diagnosed as autistic were analyzed based on: (1) Piagetian criteria of sensorimotor development and semiotic functioning, and (2) developmental levels of action competencies. The age range covered was 4 to 42 months of age. The analysis showed that, from the second year of life, timing and sequence of developmental gains in the non-handicapped and autistic children showed striking differences. In the area of sensorimotor development, actions and joint social play by the autistic children became less frequent during the age of 22-30 months, while the frequency of those activities in the non-handicapped children increased. As the autistic children grew older, they became overly involved with practicing and repeating well-known means to achieve well-known outcomes. No symbolic play was evidenced by the autistic children. The course of action-outcome development resembled that of sensorimotor development. The early differences in action-outcome development indicated developmental delay. From age 30 months onwards, developmental differences became qualitative as well, as goal-directed actions diminished, while activities producing action with accompanying continuous effects increased. (Author/JDD)

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Sensorimotor and Action Development in Autistic Children from Infancy to Early Childhood *)

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Keywords - Autism, infancy, sensorimotor development, action development

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Abstract

Home movies of eight normal children and eight children later diagnosed as autistic, were analysed according to development in sensorimotor and action competencies. The age range covered was 4 to 42 months of age. From the beginning of the second year of life, normal and autistic children show striking differences in timing and sequence of developmental gains. One year later the development of the autistic children proves to be not only delayed, but qualitatively different with respect to the more challenging kinds of action outcomes. This is particularly noticeable for actions involving mental representation of the intended outcome.

Zusammenfassung

Die sensumotorische Entwicklung und die Entwicklung der Handlungskompetenz von acht normalen Kindern und acht Kindern, die später als autistisch diagnostiziert worden sind, wurden im Alter von 4 bis 42 Monaten untersucht. Als Ausgangsmaterial dienten Super-8 Filme, die Eltern von Ihren Kindern gedreht hatten. Die Ergebnisse zeigen, daß die Entwicklung der autistischen Kinder vom zweiten Lebensjahr an langsamer verläuft als bei den Vergleichskindern. Im dritten Lebensjahr stellt sich die Entwicklung der autistischen Kinder nicht nur als verzögert, sondern als qualitativ verschieden von der der normalen Kinder dar. Dies betrifft besonders Handlungen, die die Repräsentation eines intendierten Handlungszieles erfordern.

SENSORIMOTOR AND ACTION DEVELOPMENT IN AUTISTIC CHILDREN FROM INFANCY TO EARLY CHILDHOOD

Kanner (1943) was the first to describe the syndrome of early infantile autism as a nosological unit distinct from other psychiatric disorders. Since then the continued debate about the relevant diagnostic criteria has resulted in the DSM-III description of the American Psychiatric Association (1980). The DSM-III states the joint occurrence of the following five symptoms as a prerequisite for diagnosing early infantile autism: (a) onset before age 30 months, (b) serious lack of social response, (c) gross language deficit, (d) speech peculiar, if present, (e) no delusions or hallucinations. It is commonly acknowledged that the autistic syndrome is coupled with cognitive deficiency of some kind (DeMyer et al., 1980; Rutter, 1983).

Early infantile autism is usually not identified until the children are three to four years of age. While some symptoms, such as aberrations in language, are almost impossible to identify in infancy for developmental reasons, the syndrome is assumed to exist before the age of 30 months. According to the definition of early infantile autism some abnormal behavior should be present in the early years, although little is known about such behavior. Knowledge about such early symptoms is mostly derived from anecdotal retrospective descriptions by parents or relevant others. Detailed single case studies, such as one reported by Kubicek (1980), depend on mere chance. Studies of autism in very young children have only recently been reported in more detail (Ungerer & Sigman, 1981; Mundy, Sigman, Ungerer & Sherman, 1986), but the youngest children in these reports are 34 months of age. Prospective longitudinal studies with even younger children are almost impossible since the incidence rate is extremely low. In order to provide early intervention it is highly desirable to identify early infantile autism as soon as possible, but there is a dearth of research on developmental precursors of early infantile autism before the age of three.

Rosenthal, Massie & Wulff (1980) report a new and uncon-

ventional approach to the study of cognitive development of psychotic children in their first two years. They used home movies taken by parents as a data base for investigating sensorimotor development. It became clear that even in infancy the sensorimotor development of the children later identified as autistic or psychotic was impaired. The study, exploratory in nature and intention, and with considerable methodological shortcomings, calls for further research employing a similar paradigm but improved methodology.

The present study is based on home movies of autistic and normal children taken during their first three and a half years. Two types of analysis were undertaken on the recorded activities of the children following (a) Piagetian criteria of sensorimotor development and the development of semiotic functioning, and (b) levels of the development of action competencies as proposed by Hetzer (1931).

Piaget`s theory of sensorimotor development proposes a six stage process to be completed in the first two years of life, stages two to six of normal sensorimotor development are important for the present study:

Stage 2: From about 1 to 4 months of age is the stage of primary circular reactions. Chance behavior leads to interesting body centered stimulation.

Stage 3: From about 4 to 8 months of age is the stage of secondary circular reactions involving events or objects in the environment.

Stage 4: From about 8 to 12 months of age, the infant coordinates secondary circular reactions in goal directed sequences.

Stage 5: From about 12 to 18 months is the stage of tertiary circular reactions. The child begins to search for novelty and is curious about the world around him/her.

Stage 6: The period from about 18 to 24 months of age, Piaget terms the "beginning of thought".

Subsequently the semiotic functions, with symbolic play as the most important aspect, evolve. Piagetian theory is supported by numerous empirical studies and represents a useful model of development, on the basis of which aberrations

can easily be identified.

The analysis of action development used in the present study is based on the pioneering work of Hetzer (1931) which was more recently developed by Spangler, Bräutigam & Stadler (1984). Hetzer describes the early development of action in the context of observational studies. The descriptive methodology of the approach of Hetzer overlaps somewhat with Piagetian work. Hetzer, however, is not so much cognitively oriented, but rather interested in what the child actually does and how he/she reacts to his/her own actions. Research on the early origins of achievement motivation has more recently employed the same approach. In an investigation of action development in early childhood, Spangler et al. (1984) have identified the following sequence of developmental onset for four types of actions of differing complexity:

1. Action-effect-contingency. In this type of action the effect immediately follows and terminates the action. Examples are: to hit on the table, to bang two bricks together.

2. Action with continuous effect. This type of action causes a prolonged effect which accompanies the action. The effect is dependent on the continuation of action. Examples are: to turn around in circles, to push a chair through the room, to pull a toy along.

3. Separation of action and effect. In this kind of action the effect begins with the end of the action and continues. Examples are: to throw a ball, to kick a ball, to push away a toy car.

4. Action aimed at a goal. In actions of this kind multiple steps are aimed at a final goal state. Examples are: to build a tower of bricks, to scoop sand in molds, to sort forms into a form board.

A number of authors have drawn parallels between early development of actions and sensorimotor development. H. Heckhausen (1983) for example associates sensorimotor stage six with a goal oriented action organization. Bruner & Koslowski (1972) describe a process by which a preoccupation with means

is replaced by a centering on ends. Their description of a phase of means-ends combinations resembles stage four in the Piagetian model of sensorimotor development involving the coordination of secondary schemata and their employment in new situations (Piaget, 1952). Uzgiris (1977) proposes a model which is based on the assumption that the evolution of the means-ends relation is the latent developmental process underlying a four stage development of action in the first two years.

In the present study an effort has been made to take into account these theories in the early identification of autistic as compared to normal children.

METHOD

Subjects

The initial pool of data contained films of 17 autistic and 21 non-handicapped children. The films of the autistic children were taken by their parents before the children had been diagnosed as being autistic. In eight cases sufficient film material was available for their first three and a half years; hence these children became the subjects of the study. As a contrast group eight non-handicapped children were then selected as to resemble the autistic children with regard to age, gender, sibling status, and amount of film material available for the relevant age range.

The autistic children, three girls and five boys, were born between 1971 and 1981. Two are only children, five have one sibling and one child has two siblings. The most recent diagnosis was either autism or autism coupled with mental handicap. Each of the eight children can be considered autistic according to the DSM-III criteria. None of the children had an IQ in the normal range. Two of the children do not speak at all, three developed only rudimentary speech, one stopped talking at the age of three years, two developed speech, but with typical peculiarities. None of the children developed seizures.

The eight children in the non-handicapped sample, two girls and 6 boys, were born between 1969 and 1981; two are only children; five have one and one child has two siblings. All children, autistic and non-handicapped, come from German middle-class families. In addition, four of the non-handicapped children are siblings of one of the children in the autistic sample.

Procedure

The super-8-films were copied on video-cassettes. The amount of video material available from different children varied across the age range. Careful interviews were conducted with the parents of each child especially for the estimates of the child`s age for each filming occasion. Only those scenes were taken where parental age estimates (within two months) were specific. For two autistic and two non-autistic children the entire material was used. For the other children samples were drawn from the available film material. The aim was to minimize inter-individual differences in the situations while maximizing the opportunities for the children to produce the most varied behavior. For instance, from a film "holidays at the seaside" those scenes were selected which showed the child with toys and/or persons on the shore. Not included were episodes such as family bike-ride with the child seated on his father`s bike.

For each child and each month of age the sample scenes were again edited. Only those scenes which clearly showed the target child were considered. Depending on the amount of material available for the respective child and age level the samples varied in length. A total of 266 samples (130 for the autistic and 136 for the control children), with a total duration of 11.56 hours (5.57 hrs. for the autistic and 6.02 hrs. for the non-handicapped children) were used for analysis.

In preparation for the ratings, the 266 samples were randomly ordered and separated by a 20 second period of blank tape. The units of analysis were specific episodes. In order to measure duration and number of episodes a digital clock was

superimposed on the tapes after editing.

Table 1. Amount of video material (in minutes) sampled for the group of autistic children

	Age in months				
Children	4-12	13-21	22-30	31-42	4-42
Child 1	12.7	10.9	11.8	10.0	45.5
Child 2	24.3	20.0	15.5	15.5	75.3
Child 3	10.0	14.0	5.3	7.4	36.7
Child 4	16.1	20.2	10.4	11.2	57.9
Child 5	9.6	18.9	5.4	9.9	43.8
Child 6	6.9	11.8	2.6	2.3	23.6
Child 7	--	6.6	3.6	7.8	18.0
Child 8	--	16.3	17.6	14.9	48.8
Total	79.6	118.7	72.2	79.0	349.5

Many difficulties in preparing the material for analysis resulted from the fact that the films were meant for family rather than scientific purposes. A major problem was the frequency of cuts (often after only a few seconds). In order to minimize the likelihood of disruptions by such cuts, action episodes were chosen as smallest units of analysis. The criterion for identifying action episodes was the continuous focus of the child`s attention on a particular object or person, terminated either by a shift of attention or a cut. When assembling the material no further cuts were introduced. In total the material available yielded 1093 episodes for the autistic children and 1066 for the non-handicapped children; the autistic children were the main actors in 636, the non-handicapped children in 706 episodes. For statistical analysis the raw data were grouped into four age levels: 4 to 12 months, 13 to 21 months, 22 to 30 months, 31 to 42 months.

Information about the amount of material used per age level is presented in Table 1 for the autistic and Table 2 for the normal children.

Table 2. Amount of video material (in minutes) sampled for the group of normal children

	Age in months				
Children	4-12	13-21	22-30	31-42	4-42
Child 9	12.7	19.6	18.9	17.0	68.2
Child 10	10.6	12.2	19.7	17.0	59.5
Child 11	15.9	17.6	4.3	3.8	41.6
Child 12	9.3	11.6	--	7.5	28.4
Child 13	15.9	3.3	7.5	3.3	30.0
Child 14	8.3	11.7	18.2	9.2	47.4
Child 15	13.9	16.7	8.4	2.4	41.4
Child 16	18.1	10.2	5.2	11.4	44.9
Total	104.7	102.9	82.2	71.6	361.4

Three main hypothesis were formulated in relation to the theories discussed, and coding schemes to test each hypothesis were constructed. The three hypothesis together with the coding schemes are presented below.

Hypothesis 1:

There is a significant difference between the two groups, autistic and non-handicapped contrast children, with respect to the child being the main actor in an action episode.

To test this hypothesis the two groups were compared in terms of the number of episodes in which the child was the main actor.

Hypothesis 2:

The two groups of children differ significantly in their development along the sensorimotor stages as well as in behaviors beyond the sensorimotor stages.

In order to test this hypothesis, eight categories were coded; category 1 refers to actions not codable in Piagetian terms of development, categories 2 to 6 reflect behavior at the respective sensorimotor levels, category 7 refers to symbolic play, and category 8 to actions beyond sensorimotor stages but other than symbolic play.

Hypothesis 3:

The two groups of children differ significantly in the types of action outcome.

In order to test this hypothesis, the following five categories of action outcome were coded:

1. Action with immediate effect
2. Action with continuous effect
3. Action and effect are distinct
4. Action is clearly goal directed
5. A social script is executed by the action

It should be noted that, while categories 1 to 4 follow Spangler et al. (1984), actions coded as belonging to category 5 concur with the characteristics of social scripts as defined by Schank & Abelson (1977). They are not only goal directed but clearly reveal a knowledge about social correlations. Typical examples would be symbolic games involving not only objects but also social relations, role play, and rule guided games.

Training of Raters

Blind ratings were performed by two independent raters. The raters were trained by using video material not included in the analysis. The ratings of sensorimotor development were illustrated using examples given by Belsky & Most, (1981), Ginsburg & Opper (1969), Nicolich (1977), Piaget (1952,

1962), parts of the Uzgiris-Hunt-Scales (Uzgiris & Hunt, 1975) and the clinical version of these scales from Dunst (1980). The training for rating the developmental level of actions was based on examples taken from Hetzer (1931), Spangler et al. (1984), and from Schank & Abelson (1977).

Interrater reliability was measured by having two raters independently score the items of a sample of action episodes. Reliability was calculated for each variable by dividing the number of agreements by the number of agreements plus disagreements. The reliability was 95 % for the first variable (main actor), 75 % for the second variable (sensorimotor development), and 83 % for the third variable (kind of action outcome).

For each of the three variables the relative frequencies per sample were ascertained for each category in each age period. Due to the ordinal nature of the data group differences in these relative frequencies were tested using Mann-Whitney U-Test. As each group comprises only eight subjects and since the character of the study is exploratory, trends ($p < .10$) are reported as well as differences passing conventional significance levels.

RESULTS

Hypothesis 1: Differences between the autistic and contrast children in being the main actor during an action episode.

Group comparisons: The results indicate an age dependent course, as can be seen in Table 3. The percentage of episodes in which the child was the actor does not differ between the groups during the earlier age periods one (4 to 12 months) and two (13 to 21 months). In the contrast children the percentage of acting increased continuously with age; in the autistic children, however, this was not the case. After an increase from the first to the second age period, acting in these children decreased from the second to the third age period (22 to 30 months), remaining at a low level thereafter. The differences between the groups in the third and fourth age period

(31 to 24 months) are statistically significant ($p < .01$). Hypothesis 1 is confirmed for the last two age periods, but not for age periods one and two.

Table 3. Age-dependent changes in the frequencies of episodes with the child as actor as a percentage of the total number of episodes

	Age in months			
Groups	4-12	13-21	22-30	31-42
Autistic	46.1	66.0	59.1	55.7
Normal	52.4	66.2	73.4	74.4

** Significantly different from the normal group, $p < .01$

Hypothesis 2: Differences between the autistic and contrast children in sensorimotor development.

Sensorimotor development of the contrast children: The course of the sensorimotor development corresponds well to the one typically described in the literature. Table 4 shows for the non-handicapped children an increase in complex behavior with age and a corresponding decrease of behavior characteristic of earlier stages. In age period one (4 to 12 months) stage-three behavior, as the developmental modal behavior, occured with a frequency of 56.7 %; and stage-two behavior, characteristic for even younger children, was registered in only 6.4 % of the episodes with the child as the main actor. More advanced stage-four behavior amounted to nearly 10 %. Almost no stage-five behavior (0,7 %) was observed in this age period. Behavior at a higher level was absent. In age period two (13 to 21 months), stage-four behavior predominated (33.5 %). In this age range, levels three, five, and six occured with equivalent frequencies (between 12 and 15 %). Behavior beyond sensorimotor stages was extremely rare (1.5 %). In age period three (22 to 30 months) stage six

behavior was the modal behavior (23.7 %). Moreover, behavior beyond the sensorimotor level appeared at appreciable frequency (10.5 %), whereas low-level behavior (stages two and three) was almost totally absent. In age period four (31 to 42 months) advanced behavior became predominant (36.7 %), and behavior characteristic for lower sensorimotor stages decreased.

Sensorimotor development of the autistic children: In the first age period (4 to 12 months) these children also started with a high percentage of stage-three behavior (61.7 %) as their modal action pattern. In the second age period (13 to 22 months) their behavior was still characterized by this level (48.2 %), however, there was a continuous decrease of stage-two and stage-three behavior with advancing age. The percentage of stage-four behavior increased from 9.2 % in the first to 22.9 % in the second age period. Stages five and six behavior combined amounted to 4.4 % and behavior beyond sensorimotor level was absent. In the third age period (22 to 30 months) stage-four behavior predominated (40.9 %); stage-three behavior, still at 17.5 %, was more frequent than stage-five and six behavior taken together (13.2 %). Only 2.2 % of action behavior was beyond sensorimotor level. In the last age period (31 to 42 months) the frequencies of stages four and five behavior remained unchanged while there was a considerable increase from 26.3 % to 42.3 % in behavior, uncodable according to Piagetian theory. In the autistic children no symbolic play was observed at any age period. The percentage of behavior beyond stage four was minimal on the whole, and even decreased in the last age period.

Group comparison: As the data in Table 4 indicate, there are no significant group differences in any age period for category-one behavior. For the other categories this is not the case. In the youngest age period (4 to 12 months) almost no differences between the groups occurred. Only in relatively advanced level-four behavior was there a trend to higher frequencies in the normal infants ($p < .10$). With advancing age, differences between the two groups became evident. Statistically, these differences appeared most markedly in the

second (13 to 21 months) and third (22 to 30 months) age period, where in both groups appreciable frequencies occurred in most of the categories.

In the last age period (31 to 42 months) the two groups differed with respect to almost all categories, but due to lacking frequencies in the autistic children for the advanced behavior of categories seven and eight, and in the normal children for low level behavior of category three, differences in these categories could not be statistically evaluated. With respect to stage-four behavior, which at this age level dropped sharply in frequency in the contrast group and remained stable in the autistic children, the two groups differed significantly ($p < .01$). Group differences with respect to stage-five behavior, which also decreased in the contrast group and remained stable in the autistic children, was no longer significant. In the normal children the decrease in sensorimotor behavior was combined with an increase in behavior above sensorimotor level (36.7 %). The autistic children showed virtually no comparable behavior. Instead, in their group, unclassifiable behavior (category 1) increased considerably instead.

Hence hypothesis two is confirmed for age periods two, three, and four, but not for the first age period.

Hypothesis 3: Group differences between the autistic and contrast children in the kind of action outcome.

Action development of the contrast children: In the non-handicapped children the course of action followed by and large the one described by Stadler et al. (1984). There was a sequence from actions with immediate effect (category 1) to actions with continuous effects (category 2) to actions aimed at a plainly recognizable goal (categories 3 to 5). In the present study simple actions of category one decreased with increasing age, approaching less than 2 % in the third age period. A considerable decrease with age was also noticable for category-two actions (a drop from 2/3 of the total actions in the first age period to 1/3 in the fourth age period). Goal oriented actions increased correspondingly. In the first age

Table 4: Age-dependent changes in sensorimotor level in autistic (A) and normal (N) children as a percentage of total number of episodes with the child as actor

Categories of sensorimotor development	Age periods in months 4-12		13-21		22-30		31-42	
	A	N	A	N	A	N	A	N
Category 1	25.5	27.0	23.7	25.2	26.3	29.5	42.3	32.0
Category 2	8.5	6.4	0.8	--	--	--	--	--
Category 3	61.7	56.7	48.2	14.6	17.5	0.5	4.5	--
		*		*				***
Category 4	3.2	9.2	22.9	33.5	40.9	20.0	41.7	8.3
				***		*		
Category 5	1.1	0.7	3.2	13.1	6.6	15.8	7.7	11.2
				***		*		***
Category 6	--	--	1.2	12.1	6.6	23.7	3.2	11.8
Category 7	--	--	--	1.0	--	4.7	--	5.3
						*		
Category 8	--	--	--	0.5	2.2	5.8	0.6	31.4

Categories of sensorimotor development:

1. Action is not codable in terms of sensorimotor development
2. Action corresponds to sensorimotor stage 2
3. " " " " " 3
4. " " " " " 4
5. Action corresponds to sensorimotor stage 5
6. " " " " " 6
7. Action level above sensorimotor stages: symbolic play (s. p.)
8. " " " " " other than s. p.

* p <.1; ** p <.05; *** p <.01

Due to the nature of the study a difference from normal group of p <.1 is indicated

period categories three, four, and five together moded up only to 15.6 %. Thereafter these behaviors became more frequent with 43.7 % in the second and 67.4 % in the third age period, thus characterizing about 2/3 of the total actions in this age group. In the fourth age period this proportion remained nearly unchanged. What did change was the relative proportion of the different kinds of goal directed actions in favour of actions following a social script as can be seen from Table 5.

Table 5: Age-dependent changes in five types of action in autistic (A) and normal (N) children as a percentage of total number of episodes with the child as actor

Categories of actions	Age periods in months 4-12 A	4-12 N	13-21 A	13-21 N	22-30 A	22-30 N	31-42 A	31-42 N
					***		*	
Category 1	20.4	16.3	9.2	5.3	10.3	1.6	7.1	1.8
			*				***	
Category 2	67.7	68.1	69.9	51.0	49.3	31.6	61.5	34.3
					*			
Category 3	9.7	7.8	10.4	14.6	19.1	13.7	12.2	11.8
	**				***		***	
Category 4	2.1	7.8	10.4	25.7	17.6	42.1	18.6	37.2
					**		***	
Category 5	--	--	--	3.4	3.7	11.6	0.6	14.8

Categories of action:
1. Action with immediate effect
2. Action with continuous effect
3. Action and effect are distinct
4. Action is goal directed
5. Action is the execution of a social script

* p <.1; ** p < .05; *** p < .01
Due to the nature of the study a difference from the normal group of p < .1 is indicated

Action development of the autistic children: In the first age period the relative frequencies of the categories were similar to those shown by the contrast group. From the first to the second age period the frequency of simple actions with immediate effects dropped from 20.4 % to 9.2 % and amounted to 7.1 % in the last age period. The relative frequency of actions with continuous effect remained unchanged from the first to the second age period (nearly 70 %), followed by a reduction to 49.3 % in the third age period. The relative number of goal oriented actions increased correspondingly, and for the first time actions showing an internal social script appeared. The feature of the relative frequencies of categories in age period three is much alike that of age period two for the contrast group. This development was, however, not continued in the fourth age period. Actions with continuous effect increased again and reached 61.5 %, which is almost the same amount as in age period one, whereas goal orinted actions (categories 3 to 5) dropped from 40.4 % in the third to 31.4 % in the fourth age period. In only 0.6 % of all actions, a social script was executed.

Group comparison: In the first age period only category-four (goal directed actions) yielded significant differences ($p < .05$), the second age period shows remarkable differences only for categoy two (actions with continuous effect) in favour of the contrast group ($p < .10$). In age period three this was the only non-significant difference. In the last age period the frequency of actions with continuous effect increased for the autistic children and the group difference became significant ($p < .01$). In this last age period the proportion of actions with continuous effect and goal directed actions is reversed to the proportion found with the non-handicapped children. Only about 1/3 of actions of the autistic children (31.4 %) had a recognizable goal whereas comparable actions of the non-handicapped children amounted to 63.9%. The proportion of actions with continuous effect on the other hand amounted to 61.5 % for the autistic and to 34.3% for the contrast children. As can be seen from Table 5, the remainder are actions with contingent effect.

In the main the results confirm the hypothesis. The differences become especially clear for the last two age periods.

DISCUSSION

In the present study the observed development of the non-handicapped children is in the expected direction and demonstrates the appropriateness of the methodological procedure. From the second year of life, timing and sequence of developmental gains in the non-handicapped and autistic children showed striking differences. When considering the proportion of actions performed by the autistic children, a clear decrease in the third age period (22 to 30 months) is found. Indeed, the degree of difference in action frequencies between the two groups of children is probably underestimated since care was taken to include an equivalent number of episodes affording the opportunity for action in both groups. While actions by the autistic children became less frequent during the age of 22 to 30 months, the frequency of actions in the non-handicapped children increased. It is important to note that the difference between the two groups became apparent at a time when both the autistic and non-handicapped children had learned to walk. Being able to walk substantially increases the action range of children, but the autistic children seemed to be less able to put this ability to use for increasing action potential. The non-handicapped children used walking as a means to get to something, while the autistic children walked somewhat aimlessly about. For example, on a Sunday afternoon walk in a park, a scene which is often depicted in the films, the non-handicapped children found stones, leaves, feathers and such things and were eager to explore their environment; in contrast the autistic children in a similar situation seemed to walk aimlessly, in general not noticing the opportunities for action around them. Moreover, during the same age transition the evolution of a difference between the two groups in terms of socially involved play could be observed. While, during the second age period (13 to 21

months), joint social play occurred in one third of all episodes in both groups, joint social play in the third age period (22 to 30 months) amounted to only one quarter for the autistic, but to half of the episodes for the non-handicapped children. The comparatively low frequency of joint social activities in the autistic group appears particularly noteworthy since in late infancy mothers of normal children have been found to focus on challenging developmental potential of their children in contexts of joint play around objects (J. Heckhausen, in press). When inspecting the film material it seems that not only quantitative but also qualitative differences are evolving at this age. When playing with adults the autistic children appeared as "being played with" rather than playing with them. In other words they were the objects of interaction rather then being dynamically involved.

To investigate the issue concerning the main actor during an action episode, all action episodes where taken into consideration. The analyses of sensorimotor and action-outcome developments were based only on those episodes where the child was the main actor. During the course of sensorimotor development there are almost no differences between the groups until the beginning of the second year of life. Up to the age of two and a half the differences observed could be interpreted as quantitative, indicating merely developmental delay in the autistic children. As age increased the frequency of lower order (stage 2 and 3) sensorimotor behavior decreased, and higher order behavior increased, although behavior above stage four was always rare. At an age between 31 and 42 months, however, the autistic children showed even less beyond-stage-four behavior than they did in the previous age range, they were overly involved with practicing and repeating well known means to achieve well known outcomes, while the non-handicapped children invented new means to achieve a great variety of outcomes, and a considerable amount of their behavior was at a level beyond sensorimotor development. After 30 months of age it became difficult to rate the behavior of the autistic children in terms of Piagetian theory. Especially noticeable is the difference in amount of symbolic play between both

samples. The autistic children did not show symbolic play at all, and presymbolic play occurred only rarely. These results conform with the literature (Wing et al., 1977; Hammes & Langdell, 1981; Riguet et al., 1981; Baron-Cohen, 1987). It should be pointed out that the non-handicapped children also showed surprisingly little symbolic play. While the samples differ in this respect, the differences are small and may be explained by the way the parents filmed their children, or the fact that super-8 films are without sound; on the other hand, Mundy et al. (1986) also found little symbolic play with normal children in free play situations.

The course of action-outcome development resembles that of sensorimotor development. Almost no differences could be seen during the first year of life. Differences in the first part of the second year while not attaining statistical significance are in the direction of the hypothesis. Although it is important not to overemphasize the data in these younger children, differences in these variables might be obtained using different methodology and research designs. Thus evidence of differences in the younger children should be further investigated.

The early differences in action-outcome may be interpreted, as were the differences in sensorimotor development, as indicating developmental delay. In the last age period (30 months onwards), however, goal directed actions diminished, while activities producing continuous action accompanying effects increased, which is hardly to be interpreted as developmental delay. The non-handicapped children in contrast, reached the next step in the development of action related competencies. Their actions, as opposed to those of the autistic children, reflect an increasing competency to differentiate an anticipated action outcome from the action itself. Moreover, much more than the autistic children, they appeared to gain an increasing knowledge about the social world around them as indicated by their execution of social scripts.

The parallels between the course of sensorimotor and action-outcome development concern the means-end relation of actions. The action analysis according to both theories shows

a "preoccupation with means" for the autistic children, while the non-handicapped children go beyond this stage to focussing on the end. With the focus on the end, there may be an anticipation of it and possibly a searching for a means to attain it. If problems arise in trying to reach anticipated goals, normal children in the second half of their second year will often try hard to solve them unlike the autistic children. It might be debated whether autistic children - at least some of them - not only do not develop a "theory of mind" as was suggested by Baron-Cohen et al. (1985), but already do not easily progress from stage four of sensorimotor development. This might explain the stereotype behavior which is shown by most of the autistic children.

The consequences for a child being arrested at stage-four behavior may be that the salient dimensions of stage-four (and even stage-three) behavior become the child`s main focus. In this connection, self stimulating body related activity which is quite natural in normally developing infants becomes exaggerated in autistic children resulting in classically observed stereotype behavior. A note of caution is in place, since the present study was not (and could not have been) a systematically designed prospective one, but rather was based on home movies. Therefore the findings of a developmental arrest at stage four, concerning problem solving behavior, clearly require further study. In those cases of autism in which it is known that the children progressed quickly through stage 4 it would be important to know whether such children also produce stereotype behavior and, if they do, whether it is body centered or object oriented. For further research work an interesting contrast group in this connection may be a matched group of mentally handicapped children who also were known to have arrested stage four sensorimotor development.

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